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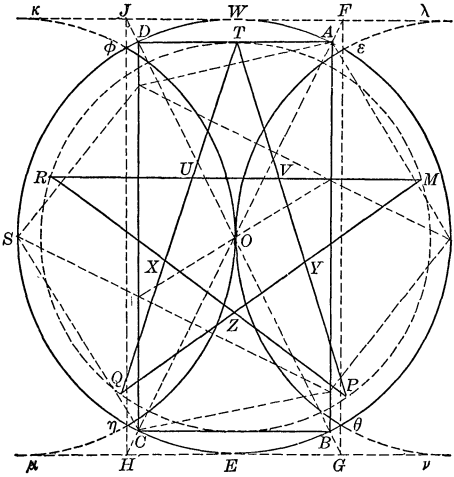
jecting this and its reflex on AB, CD we have of course the projection of the icosahedron on the plane containing two opposite edges AN, SC, while $UVYZX$ is one face of the internal dodecahedron formed by joining the 12 angular points of the icosahedron.

This diagram appears to show a relation between the *vesica piscis* and the "length-double-the-width" features of some archaic architecture. Incidentally it shows that the inscription of a square in a semicircle places the icosahedron in the sphere at one stroke, so to say.

Taking AN or TM, an edge of the icosahedron, as unity, the edge of the internal dodecahedron is represented by the limit of the sequence

$$\tfrac{1}{2}, \tfrac{1}{3}, \tfrac{2}{5}, \tfrac{3}{8}, \tfrac{5}{13}, \tfrac{8}{21}, \tfrac{13}{34}, \ldots,$$

the elements of which are formed in obvious fashion from the elements of the series of Fibonacci.[1] This series is found in nature. In certain species of plants, the denominators give the number of shoots or twigs corresponding to a number of spiral circuits given by the numerator.



It seems just possible that the geometers of ancient Egypt who, like the later Pythagorean and Platonic schools, derived their knowledge from ancient Âryâvarta, knew well what they meant when suggesting that the world-universe was built on number and the geometry of the dodecahedron. And it may be that we possess the merest fragments of what was actually taught in the temples of old. But we do have some of their mighty works in stone. Have they been read and fully understood?

RECENT PUBLICATIONS.

REVIEWS.

Euclid in Greek. Book I, with Introduction and Notes. By SIR THOMAS L. HEATH. Cambridge, 1920. Pp. x + 240. Price 10s.

Nearly ten years ago Sir George Greenhill, sitting at his baize-covered work table in Staple Inn, Holborn, in an old-world library well known to many scholars from many lands, made the remark to a visitor from over seas that he felt that the only way to teach plane geometry was by a study of Euclid in the original Greek. The remark led to an interesting discussion upon the present state of education, with the result that the distinguished scholar took the ground that his opinion was by no means chimerical; while his visitor, although lamenting the present debasement of scholarly ideals on the part of certain educational leaders, maintained that such a plan was hopeless of accomplishment in the present generation.

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[1] See the article by R. C. Archibald in this MONTHLY for May, 1918, vol. 25, p. 235.

And now, of all times, when the world seems bent solely upon selfish class activity, when every group seems determined to profit by the misfortunes of every other group, and when idealism seems to have died the death of the martyr, there comes like a voice from another sphere one of the most interesting little volumes that has appeared from the educational press in many a year,—scholarly in composition, delightful in style, and dignified and artistic in its typographical features. When one thinks of the state of mind in which Europe finds herself at present, the book is a surprise; when he looks at the other books which have recently come from her various presses, with their poor paper and poor press work, the feeling of mere surprise becomes one of pleased astonishment.

Anticipating the protest of *οἱ πολλοί* in the group of modern educators Sir Thomas faces the issue very frankly in his preface:

"In these days when Greek is supposed to be on its trial and Euclid happily defunct, it may well seem a wildly reactionary proceeding to suggest to teachers a combination of the two, a piling (so it might be thought) of one inutility on another. But, first, we must bear in mind that it is only compulsory Greek that is threatened: when that is gone, the study of Greek will be no whit less necessary to a complete education. Generation after generation of men and women will still have to go to school to the Greeks for the things in which they are our masters; and for this purpose they must continue to learn Greek. Again, Euclid can never at any time be more than apparently in abeyance; he is immortal. Elementary geometry will also continue to form part of a complete education; and elementary geometry *is* Euclid, however much the editors of text-books may try to obscure the fact."

Such words may properly be looked upon as food for thought, not merely in England and in Europe generally, but in America as well. Surely the reign of the educational destructionists must be nearly over in this country,—that is, of the young and vigorous group of those who destroy without rebuilding, setting individual tastes above all world experience, and unceasingly talking about social uplift while encouraging in every possible way all intellectual debasement. If this reign is in reality drawing to a close, as indications seem happily to show, and if we are about to rebuild our educational structure, then the question may very properly arise as to whether elective Greek may not find a welcome in our newer type of progressive senior high schools.

If such should be the case, there might well replace some of the literary classics studied in the past that scientific classic, read more widely than any of the other great pieces of literature that Greece produced, published in more editions than all the other scientific works of the ancient world combined, namely, the Elements of Euclid, of which Sir Thomas Heath has already given us the best complete edition and of which he now gives us Book I in a form adapted to the needs of the schools.

What would be the effect upon the pupil of studying Euclid I in the original Greek, not as a required task but as an elective subject? It would undoubtedly be two-fold in its nature. In the first place, Greek would have a new significance. In general this language has been studied in this country largely as a piece of linguistic gymnastics, and that is one of the reasons why it has so sadly fallen. If it had been taught for reading purposes, for the sake of knowing how the Greeks thought and acted, and for the influence which it should exert in the use of our English tongue, it would never have fallen to its present low estate. If it could, even for a short time, be shown to apply to another line of intellectual activity, one more closely related to another subject in the curriculum, there can be no doubt that students would look at it in quite a different light.

In the second place, geometry would have new significance and a more potent striking force. Those facts which we acquire by serious work are the ones that stay with us. The current theories of tabloid education, whereby we get the thought of Greece, of Rome, and even of the foreign lands of to-day in condensed translations, are too unpsychological to stand for long. In the realm of geometry the case is not the same, since this science still requires some vigor of thought; but the study of a single book of Euclid in the Greek, supplementing the regular course in mathematics, could not fail to impress the meaning of the science upon the pupil's mind and to show him the dignity and logic of geometry at its best. That this will be at all general in American schools is not to be expected, at least until we get a new generation of educators, but that it could be tried with profit in those schools that still emphasize scholarship would seem to be evident.

The work consists of three parts, (1) the introduction, 40 pages; (2) the Greek text of Book I, 70 pages; and (3) the notes, 120 pages. The introduction, writ en in a style that will appeal to students as well as teachers, contains a brief biography of Euclid, a résumé of the history of geometry in Greece, a sketch of the later history of the Elements, particularly among the Arabs and in medieval Europe, and finally a brief statement of the position of Euclid in the domain of education since the making of the first translations into Latin.

The text itself is clearly printed,—much better indeed, than the English version in such school editions as the familiar ones of Todhunter and Simson.

It is in the notes, however, that the student, the teacher, and the general reader will find the editor at his best. No other living writer can so skillfully interpret to the English reader the finer shades of meaning of the Greek mathematicians, and to the teacher of elementary geometry it will be an inspiration to read this critical study of the first part of the greatest textbook on the subject, all the circumstances considered, that the world has ever produced. To the teacher who has never critically considered, for example, the definitions of straight line, plane, angle, and circle; or who feels that he has come upon an epoch-making discovery that postulates and axioms are essentially the same, or that the Greeks so considered them; or who thinks that he rivals Euclid by finding some new sequence for his propositions or some new foundation on which to build,—to such a teacher these notes will seem like the words of one having authority and not as those of the educational scribes and Pharisees.

Not least among the valuable features of the work is the index of Greek terms and the index of proper names, aids which readers so often miss in books of this general nature.

In America the book will serve an immediate purpose, in that it is one of the few books on geometry that no teacher can afford to be without, that is indispensable in the library of any well-equipped high school, and that the general reader with scholarly taste will welcome as a pleasant relief from most of our current educational literature. But it is also to be hoped that it will serve still another purpose, the one already referred to as supplying a new classic for those elective courses which may very likely come with the development of a better and more modern type of senior high school in this country.

DAVID EUGENE SMITH.

Theory of Maxima and Minima. By HARRIS HANCOCK. Boston, Ginn and Company, 1917. xiv + 194 pages. Octavo. Price $2.50.

The little treatise deals with maxima and minima, the first half being concerned principally with the case of functions of two variables. The first chapter disposes effectually of the one dimensional problem, and some sections treat in particular examples of three independent variables. The second half, chapters V to VIII, treat the general case. Ordinary and extraordinary maxima and minima, the latter occurring only at irregular points of the function are considered, and considerable space is given relative extremes in addition to the usual discussion of absolute extremes. The discussion treats the problem from many points of view and is particularly rich in elements common to other mathematical disciplines.

The principal topics emphasized are homogeneous forms, definite, semidefinite, and indefinite, and their relation to the determination of maxima and minima; the fallacy of the Lagrangian criterion by which the point in question is approached on straight lines only; various attempts to improve the theory particularly those of Stolz, Scheefer, and v. Dantscher; homogeneous quadratic forms in many variables; the treatment of conditions by obvious and also by more symmetric methods; applications to geometrical and physical problems; subsidiary conditions as inequalities rather than equations of condition; Gauss's principle in problems of mechanics; reversion of series; certain fundamental conceptions in the theory of analytic functions, such as analytic and algebraic dependence, and algebraic singularities.

The readers of the MONTHLY are doubtless most interested in the question as to the place in a college curriculum this book may be expected to fill. The author mentions in his preface, "As introductory to a courese of lecture on the calculus of variations, I have for a number of years given a brief outline of the